Vehicle-Grid Integration ~~Communications Protocol~~ Working Group

CPUC and CEC Staff Straw Proposal 3/9/17 (edits from SCE, PG&E, SDG&E & EPRI)

Objective: Enabling economical Plug-In Vehicle Grid Integration (VGI) will help achieve California's greenhouse gas and air pollution ~~-~~reduction goals by promoting EV adoption with improved value propositions and by optimizing EV charging resources. The California Public Utilities Commission, California Energy Commission, and other State agencies, with broad stakeholder input, will assess the current barriers to VGI solutions and the potential remedies including technical, implementation, and markets. Specifically the Working Group will assess how and whether the adoption of a communications protocol or protocols is necessary to enable ~~Plug-In Electric Vehicle-Grid Integration (~~VGI~~)~~ resources to more economically participate in electricity markets at scale, will~~-~~ evaluate the grid and consumer value of non-wholesale market alternatives (e.g., distribution infrastructure services and customer facing services), and will make recommendations to achieve high priority VGI solutions in order to provide grid and EV driver benefits.

Strategy: Form a working group to identify and assess opportunities in which VGI can create value from multiple ~~market~~ participants' perspectives, ~~communication protocols~~ solutions needed to deliver that value, and concepts for how utilities, automakers, electric vehicle service providers, aggregators, and others can develop pathways to implement ~~market for a~~ VGI resources (wholesale services, distribution infrastructure services, and customer-facing services). The working group will allow participants to review, understand, and discuss in 2 key workstreams:

- *Understand the VGI business~~-~~ value / use cases for Different Stakeholders, Define the Problems & Criteria for Evaluation of VGI Solutions* - based on criteria including, but limited to, saving money for EV drivers and utility customers, and the guiding principles developed in 2016 by the CPUC Energy Division and in 2017 by the utilities.
- *Technical Barriers to achieving VGI Solutions/ use cases* - the technical details of existing communication protocols/architecture

After developing priority VGI solutions and use cases for market and non-market solutions, the working group will evaluate them to recommend high priority actions. The recommendations of the working group will be considered and incorporated in CPUC's Rulemaking 13-11-007 (and/or the SB 350 Transportation Electrification applications A.17-01-020, A.17-01-021 and A.17-01-022) and the Energy Commission's Integrated Energy Policy Report (IEPR) proceeding for future policy decisions~~.~~

Work~~-~~streams , ~~and~~ Deliverables and Questions for Working Group to consider~~:~~

Understand the VGI business value for Different Stakeholders, Define the Problems & Criteria for Evaluation of VGI Use Cases/ Solutions - Review of current landscape and problem resulting in a report that answers the following questions:

1. Review research that has been conducted in California and globally by utilities, automakers, charging companies, and others related to VGI. What lessons learned from the research are relevant to working group activities? Develop new terms to minimize miscommunication and develop a glossary of terms to use.

2. Review existing and identify any additional potential VGI use cases/ solutions for wholesale market services, distribution infrastructure services, and customer facing services.[1] How can customers, third parties, and utilities extract value from these use cases?
3. Review the current technical and economic barriers to implementing VGI use cases. Identify any market barriers that may be addressed by state action.
4. Understand the business requirements /grid values (e.g., reducing generation costs, improving reliability, demand leveling, renewables alignment, mitigating local distribution infrastructure and measuring fuel switching environmental benefit) to help determine and prioritize the various use cases/ solutions for wholesale market services, distribution infrastructure services and customer facing services.
5. What are the additional solutions outside of a market application (e.g. TOU and demand charge rates, buying low level charging stations)? For market resource VGI, are there inherent advantages to this type of VGI solutions compared to other market resources (e.g. stationary batteries or compressed air)? If not, how big is the market, and who are the competitors to VGI market resources?
6. Understand the needs of the various actors (e.g., carmaker, driver, utility customer, charging station operator, market aggregator)
7. What are the criteria/objectives that should be used to prioritize the VGI use cases in both market and non-market applications (e.g., avoiding costs to all ratepayers, reducing cost of charging or charging infrastructure)? Are some criteria more important than others? For different charging market segments (e.g. home, workplace, fleet) where EVs are parked for a long-time, develop basic use cases focused on EV drivers saving money, and advanced use cases focused on wholesale market services. Determine if high level charging (home or away-from-home) should receive additional focus. Determine which complex use cases, if any, should be in scope (e.g. principle agent challenge or multiple actors)
8. What frameworks, outcomes, or criteria have prior studies employed to analyze the functionalities, costs, efficiency, interoperability, (or other factors) of VGI communications protocols?
9. What is the EV driver interest in the value from grid services (market and non-market)?
10. Determine what information flow is needed
11. Evaluate future state visions (e.g. 2040) for charging station impact on the grid in order to provide bounding cases on costs and benefits to all utility customers especially for distribution infrastructure services and customer facing services (e.g., different mixes of short- and long-range BEVs and PHEVs, different mixes of home and away-from-home charging, different base levels of charging in the various segments)

Technical Barriers to VGI Solutions - Identification and discussion of communications protocols resulting in a report that answers the following questions:

12. Review the existing applicable communication protocols.
    a. For a VGI resource regulated at the EVSE, how can different communication protocols enable a pathway to utility markets for the VGI product?

[1] The California Vehicle-Grid Integration Roadmap (2014) identified "value of VGI" as one of three barriers and identified "refining use cases" as an action item. Roadmap is available at: https://www.caiso.com/Documents/Vehicle-GridIntegrationRoadmap.pdf. Also see Energy Division's VGI white paper.

b. For a VGI resource regulated at the EV, how can different communication protocols enable a pathway to utility markets for the VGI product?

c. What are the pros and cons of each communication protocol?

~~c.~~ What are the criteria to evaluate end-to-end solutions (one or more communication protocols) from EV to the grid (e.g. point of control)?

d. What are the projected communication layer costs with current day market ~~participants.~~participants?

~~6.~~13. What are the existing or proposed network architectures for VGI? How are existing network architectures designed to host communication protocols in the devices needed for VGI? What are the pros/cons of each architecture? Can these architectures support multiple communication protocols?

~~7.~~14. Can selecting an open-source network architecture enable the market to test, implement, and continually improve multiple protocols while maintaining simplicity for drivers? What are the implications of architecture design for market participants manufacturing devices?

~~8.~~15. How do proposed protocols fit within the larger context of communications between vehicles, EVSE, the grid, utilities, automakers, EVSPs, and other distributed energy resources?

~~*Implementation & pathways to market*~~

~~9.~~16. How have IOUs tested whether proposed protocols/architectures are effective in facilitating VGI and what improvements should be made to enable scale? What contractual terms and conditions should utilities include in procurement or other programs to ensure EVs can provide grid value?

~~10.~~17. What technology, hardware, and/or software is currently available to test the proposed protocols? Where are technology gaps?

18. How do automakers, charging providers, and IOUs measure the value of the proposed protocols and whether implementation will be cost-effective? How could market participants measure cost-effectiveness?

19. How do the selected end-to-end use cases for wholesale market services (communication protocol(s)/ architecture(s)) compare based on the selected criteria (discussed above)? How will large scale adoption of non-market solutions impact the viability of market solutions? Are there particular use cases that are best suited for VGI market services (e.g. fleets)?

Final Report

20. Recommend possible ways to improve residential and commercial rates for EVs, and encourage charging stations that have less impact on the electric grid in order to encourage VGI and meet the other, agreed-upon criteria

~~11.~~21. Assuming that some non-market VGI solutions will exist, recommend for wholesale market services communication protocol(s) / architecture(s) for the priority use cases studied if any are needed, and next steps for yet-to-be-studied uses cases or grid services.

Scope:

- Focuses primarily on light duty vehicles, but seeks synergies with the medium duty and heavy duty vehicles sector.

- Understands the business case / value of VGI as a market or non-market resource from different perspectives (e.g., utility ratepayers, EV drivers, market aggregators, automakers, charging service operators, etc.)
- Assesses existing protocols or standards as defined and/or anticipated today, does not attempt to develop a new protocol.
- Relates to CPUC/IOU or other state agency investments in transportation electrification. For example, if the CPUC adopts one or multiplea protocols, it would mean that future IOU investments in transportation electrification must be compatible with thoseat protocols. It would not preclude the use of additional protocols.

Working Group Participants:

- State Sponsors: Public Utilities Commission, Energy Commission, Air Resources Board, and Governor's Office of Business and Economic Development.
- Facilitator: Independent technical expert (engineer) with experience in facilitation who is not a party to any CPUC proceedings, or existing recipient of State funding related to transportation electrification or alternative-fueled vehicles.
- Participants: Utilities, automakers, EV service providers, ratepayer advocates, nonprofits, participants in standards development, and other interested groups.

Timing:

- March 2017: establish working group.
- April-September 2017: facilitator holds bi-weekly conference calls.
- October 2017: facilitator will prepare and submit report of working group recommendations to the service list.
- November 2017: Parties may submit comments and reply comments on the report.

Appendix (attached) - Straw Proposal on Guiding Principles for Evaluating VGI solutions

Straw Proposal

Guiding Principles for Vehicle Grid Integration Working Group

These Guiding Principles/ Criteria summarize the Appendix B guiding principles from the CPUC Assigned Commissioner Ruling, Sept 2016 as well as comments expressed by parties at the Dec 7 multi-agency workshop on VGI, and the April 24, 2017 VGI Working Group launch meeting in an effort to organize the wide range of concerns into a handful of high-level categories of criteria that the Working Group can align around for evaluating Market and Non-Market VGI Solutions.

Meet EV Drivers' Needs & Preferences

- A driver's mobility, need for simplicity, and privacy is preeminent (ACR 1)[2]
- A vehicle's charging behaviors is consistent with the battery management system and mobility requirements are not externally curtailed by an entity without consulting the driver (ACR 2)

Reduce and Balance Costs of Achieving Greenhouse Gas and Air Pollution Reductions with TE

- Guarantee and hasten opportunities for the return of ratepayer investments in research and development (R&D) (ACR 11)
- Reduce up front and end use costs to site hosts and end customers (includes network fees)
- Reduce costs to all utility ratepayers
- The standard is adaptive to automakers' design and manufacturing requirements which are, ultimately, global in nature. Regulations incorporating standards should strive to recognize existing progress and avoid duplication (ACR 8)

Enable Grid Value that is Safe, Reliable, & Scalable

- Functions enabled through the standard's implementation are fully scalable: a) In electrical system terms, from an individual vehicle, to an array of EVSE, to facility circuity, to a campus/microgrid, to distribution, and to regional transmission systems, and b) In magnitude to accommodate millions of vehicles of different makes and models (ACR 3)
- Reliability and functional requirements meet those of the California Public Utilities Commission's adoption of Utility Electric Rules, Federal Energy Regulatory Commission as implemented by the CAISO, or the best practices of the North American Electric Reliability Corporation (NERC) (ACR 4)
- Functional and Safety Requirements for integrating EVs as a BTM DER asset

Enable the Future Development of the VGI Ecosystem

- Technologies and equipment deployed through the standard's implementation are resilient to evolving use cases in the automotive, electricity, and communications industries including: high-power charging, wireless charging, vehicle-to-grid, autonomous, connected, electric and shared (ACES) vehicles, higher-speed wireless and wire-based communications (ACR 5)
- Technologies and equipment deployed prior to the standard's implementation can voluntarily be re-equipped to increase functionality and compatibility to the adopted standard to the cost-effective extents possible (ACR 6)

[2] ACR X denotes the criteria was listed as "Exemplary Criteria" in Appendix B of the September 14, 2016 ACR on SB 350 TE applications (pg. B5-B6)

- Transportation Network-specific use cases and services will be leveraged and account for Geospatial Information System (GIS) data including charging infrastructure utilization, road infrastructure utilization, route navigation, demand sequencing and queueing, traffic flow, and trip dispatch (ACR 7)
- Resolution of primacy of control conflicts and alignment of customer objectives
- Flexibility to address dynamic data exchange and functional requirements from multiple stakeholders/actors - Between and amongst primary and secondary actors
- Extensibility toward future VGI technologies (i.e. V2G, V2B, V2H, DER, ZNE, Connected Cars), while Safeguarding against technology obsolescence and stranded assets
- Coexistence and interoperability for variety of services and technologies in the VGI ecosystem
- Ability to foster 3rd party innovation, customer choice and competitive marketplace (e.g., open standards/protocols)

Coordinate Across Policy Stakeholders and Related Technologies

- Synchronize the timing of public and private investments in developing vehicle, infrastructure, and network or data management products with timelines established in California policy and regulations to efficiently meet climate change mitigation and adaptation goals. (ACR 9)
- Leverage the technical capability of the State agencies, and the research and interests of the national labs of the U.S. Department of Energy and independent research institutions and standards making organizations (ACR 10)
- Consistency with Rule 21 SIWG DER Integration Principles, avoiding new silos for PEVs as DERs
- IOU-side uniformity and unanimity with other approaches to aggregated & distribution system level grid management
- Consistency across Medium and Heavy Duty Vehicle Segments re: High Power Charging

Provide for Cyber Security and Flexible Data Exchange

- Conformance to NISTIR 7628 Cybersecurity Guidelines for Smart Grid communications protocols
- EPRI defining VGI architecture requirements for cyber security implementation and verification